

GE
Digital Energy

Kelman MINITRANS™ User Guide

Transformer Oil
Dissolved Gas and Moisture Monitor



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1 INTRODUCTION

1.1 Product Overview

The MINITRANS™ (herein referred to as the product) is an on-line DGA (Dissolved Gas Analysis) system for transformer diagnostics. The product measures the following key fault gases in transformer oil: **hydrogen, carbon monoxide** and **acetylene** as well as moisture in the oil and the transformer load current. Such data provides insight on transformer condition criteria, such as developing faults, paper degradation and electrical arcing. Once installed, operation is straightforward. All results are stored within the product, but can be downloaded to a PC for analysis.

The key features and characteristics are summarised as follows:

- Utilises dynamic headspace sampling to extract target gases from the oil sample.
- No consumables, such as carrier gases are required.
- Accurate results are available as often as once per hour.
- Minimal maintenance*.
- Uses highly accurate and stable Photo-acoustic Spectrographic technology.
- Fully embedded microprocessor with non-volatile internal memory storage for 10,000 records.
- Stainless steel outdoor-rated IP55 enclosure connected to the transformer by robust stainless steel tubing.
- All gas sensing is carried out internally – no external gas sensors.
- Transformer load tracking is available.
- One user-configurable relay contact based on absolute gas and moisture values.
- Two sunlight-visible LED arrays on the exterior of the enclosure – one green for power, one red for alarm.
- Communication options include: Ethernet, RS-232, Cellular modem (GSM/GPRS), PSTN modem, RS-485 and Fibre Optic. Other options may be available on request.
- Internal USB connection provided for commissioning and service, or local data download.

*Note: The only recommended maintenance is periodic cleaning of the air filters, in-line oil filter and battery replacement.

1.2 Manual Scope

This guide outlines the use of the LCD display panel, manual DGA sampling function and general maintenance activities.

2 SAFETY

2.1 Symbols



General Warning or Caution. Refer to the Installation Manual / User Guide to prevent injury or damage to equipment.



Electrical Hazard. Risk of electric shock.



Primary Protective Earth connection.



Hot surfaces may be present.

2.2 Warnings



The minimum ambient temperature for installation and service activities is -10°C .



If the equipment is installed or used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



If working at height, third parties must have received appropriate training for working at height prior to work commencing. This includes, but is not limited to "Working at height training".



If working at a height greater than 4 feet or at a height greater than that stipulated by national or site regulatory requirements, it is the responsibility of the user to ensure that planned work complies with those requirements.



The user shall also ensure that any third-party equipment, such as an approved platform, scaffold or lift is suitable and safe before commencing work. **Ladders or improvised platforms do not meet GE service engineer requirements.**



Once installed, this product may have more than one source of supply. Disconnect all supplies at their source before accessing the cabinet for servicing. Follow the site lockout-tagout (LOTO) procedure.



Disconnection from the supply is achieved through the external circuit breaker or switch.



Ensure all power sources, including relays, are de-energised as stipulated by LOTO requirements before removing inner covers.



The product is operated with the door shut under normal use. The door shall be kept locked and should only be opened for service access by suitably qualified and authorised service personnel. During service access, hazardous voltages are accessible.



Only GE-trained and certified personnel may commission GE products. Commissioning tasks include making any connections and/or performing any work within the enclosure, or performing tasks such as purging the oil circuit between the transformer and the product, and/or all first start-up procedures relating to equipment or firmware/software.



The product provides IP55 level water spray protection. It is possible for a water deluge system to exceed IP55 thresholds depending on the location, pressure and direction of the water jets. Therefore should customers require testing a water deluge system in the area in which the product is installed, GE recommends powering down the product and draping it with a suitable waterproof covering.

2.3 Hazardous Substances

The gases measured in the product are extracted from the oil and expelled to the atmosphere. These gases are at concentrations that are nonflammable, nontoxic and quickly diluted in the surrounding atmosphere. The expelled gases are not hazardous to health or life.

3 TECHNICAL SPECIFICATION

The product meets the following technical specification as outlined in Table 3–1.

Table 3–1: Technical specification

PARAMETER	VALUE/MEETS
GAS MEASURED	MEASUREMENT RANGE (ppm)
Hydrogen (H ₂)	5 – 5,000 * ¹
Acetylene (C ₂ H ₂)	3 – 50,000 * ¹
Carbon Monoxide (CO)	10 – 50,000 * ¹
ACCURACY OF GAS MEASUREMENTS	± 10% or ± LDL (whichever is greater)
Moisture (H ₂ O)	0 – 100% RS (given in ppm)
ENVIRONMENTAL	
External temperature range	–35 °C to 55 °C
Oil temperature range	–10 °C to 100 °C* ²
Operating humidity	10 – 95% RH non condensing
Altitude	Up to 2000 m
Atmospheric pressure	Up to 1050 mbar
Enclosure	IP55
Weight	30.5 kg (68 lb)
POWER REQUIREMENTS	90 V AC to 264 V AC, 47 Hz to 63 Hz, 6 A max
Single phase Alarm Relays: NO and NC provided	1 A 250 V AC, 300 mA 110 V DC, 1 A 30 V DC
Fuses * ³	Mains: 10 A 500 V (Cooper Bussmann BAF), 10 x 38 mm Accessories: 2 x 2 A 250 V (Littelfuse 392 T)
MEASUREMENT FREQUENCY	Variable – Once per hour to once every 4 weeks

*¹ Note: Accuracy quoted is the accuracy of detectors during calibration; gas-in-oil measurement accuracy may also be affected by sampling and/or oil type.

*² Note: Based on testing carried out using VOLTESSO™ 35 mineral oil over a ¼ in. pipe run of 10 metres or less from oil supply or return valve to product connection point, and on transformer oil supply valve volumes of 200ml or less. For oil temperatures colder than -10 °C, GE recommends the use of heat trace cabling on piping.

*³ Note: Use only the approved and recommended fuse to ensure continued fire protection and compliance.

4 DESIGN CRITERIA

The product is designed to meet the following type tests as listed in Table 4–1:

Table 4–1: Type tests

Category	Standard	Class/Level	Test
EMC Emissions – EN 61326-1:2006	CISPR 11	A	Radiated & Conducted Emissions
	FCC Part 15	A	Radiated & Conducted Emissions
	IEC 61000-3-2	A	Harmonic Current Emissions Limits
EMC Immunity – EN 61326-1:2006	IEC 61000-4-2	IV	Electrostatic Discharge
	IEC 61000-4-3	III	Electromagnetic Field Immunity
	IEC 61000-4-4	III	Electrical Fast Transients
	IEC 61000-4-5	III	Surge Immunity
	IEC 61000-4-6	III	Conducted RF Immunity
	IEC 61000-4-8	IV & V	Magnetic Field Immunity
	IEC 61000-4-11	III	Voltage Dips & Interruptions
	IEC 61000-3-3	Pst 10 min, Plt 120 min	Voltage fluctuations & flicker
Environmental	IEC 60068-2-1	–35 °C	Cold
	IEC 60068-2-2	55 °C	Dry Heat
	EN 60529	IP55	Degree of Protection
Safety	IEC 61010-1		2010
	EN 61010-1		2010

5 POWER

5.1 Introduction

The product is powered up by pressing the Power switch located inside the product towards the bottom right-hand side (see Figure 5—1). The mains fuse holder for the product is shown in Figure 5—2.

Note: The product automatically turns on the internal heaters to increase the internal temperature to within the PGA operational temperature range before a measurement can commence.



Figure 5—1: Power switch



Figure 5—2: Fuse holder

5.2 LED status indicators

The product has two relays — a service relay and a caution and alarm relay — and two corresponding external sunlight-visible red and green LEDs on the front door. When the product is connected to the mains power and is powered on, the green LED illuminates continuously. Each LED has three states – Off (-), On or Flashing, the meaning of which is defined in Table 5—1.

Table 5—1: External LED status indicators

Mode	Alarm (red) LED	Power (green) LED
Power Off	-	-
Normal	-	On
Alarm	On	On
Caution	Flashing	On
Service	-	Flashing

- Relay 1 notifies the user of a service error.
 - The green LED flashes if internal error checking detects an error condition. If after the next measurement run, no error conditions exist, the green LED resumes continuous illumination.

- Relay 2 notifies the user when a user-configurable caution and/or alarm threshold is reached.
 - The red LED indicates a caution and/or alarm state. Flashing denotes a caution state whereas continuous illumination denotes an alarm state. If after the next measurement run, no alarm or caution states exist, the red LED switches off. Use the TransConnect software to set alarm and caution limits for many different combinations of results. (See the TransConnect user guide for more information).

5.3 Battery

The product uses a non-rechargeable lithium coin cell battery (Panasonic CR2450 3 V 620 mAh) as shown in Figure 5–3. In the event that the battery needs to be replaced, data from the product must be backed up. Failure to do so may result in historical data loss.



Figure 5–3: Coin cell battery



The following steps describe how to change the battery:

1. Back up the product data – contact your GE representative.
2. Open the inner door to locate the battery on the system board (as shown in Figure 5–3).
3. Slide the battery out of its housing.
4. Replace with a new Panasonic CR2450 3 V 620 mAh coin cell.
5. Close the inner door.



There is a danger of a new battery exploding if installed incorrectly.

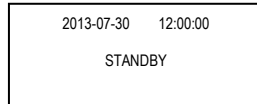


Dispose of the used battery in accordance with local regulations – not in a fire or with household waste. Contact your local waste disposal agency for the address of the nearest battery deposit site. Perchlorate material – special handling may apply. See: www.dtsc.ca.gov/hazardouswaste/perchlorate/

5.4 Power-down procedure

If the product needs to be powered down during shut down of the transformer, perform the following steps:

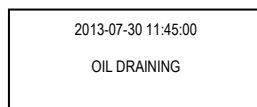
1. Observe the operating mode on the LCD.



2. If the product is in *Standby* mode, perform the following steps:
 - a. Open the door of the product and turn the power switch to the 'Off' position as shown below.



- b. The external switch or circuit breaker shall be turned to the 'Off' position.
 - c. The oil valves at the transformer to the input and output of the product shall be turned to the 'Off' position.
3. If the product is in *Operation* mode, perform the following steps:
 - a. Use PERCEPTION / TransConnect to stop an active measurement.
 - b. The LCD will read *OIL DRAINING*. This process may take several minutes.



- c. When the product returns to *Standby* mode, turn the power switch to the 'Off' position.



- d. The external switch or circuit breaker shall be turned to the 'Off' position.
- e. The oil valves at the transformer to the input and output of the product shall be turned to the 'Off' position.

Note: To resume power, first ensure that the transformer oil valves connected to the input and output of the product are returned to the 'On' position, then turn on the external switch or circuit breaker and finally turn the product's power switch to the 'On' position. The product can now resume taking scheduled readings.

6 LCD DISPLAY PANEL

The LCD display panel is visible through the door cut-out as shown in Figure 6—1.

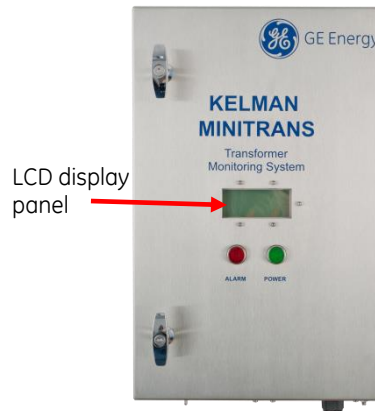


Figure 6—1: Front view of the product

During an analysis, the display panel shows the serial number of the product and the operational state. Automatic paging shows the last measurement results with date and time stamps (see Section 6.1 for examples).

In the event of an error, details are shown on the PRODUCT display panel (see Figure 6—2 for an example). The middle line indicates the state within the measurement process at which the error occurred – denoted by a double-digit code. For example, 02 indicates an error in the oil purging state. The last line indicates the errors in that state – denoted by a sequence of double digits codes each representing a specific error. For example, 18 means that the oil pressure is too low (see Section 6.2 for a list of error codes and their meaning).

Note: When contacting the Customer Service Centre, ensure that you provide the state code and error code.

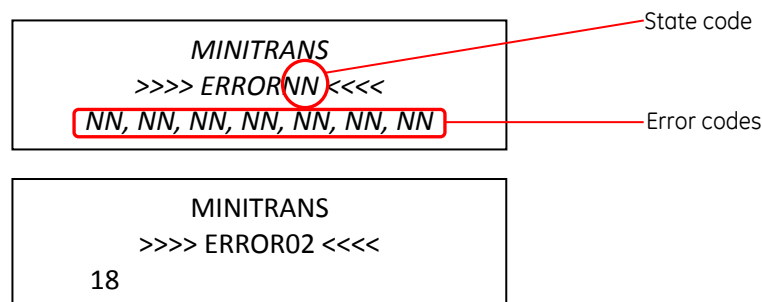


Figure 6—2: LCD information notice – error format (top) & example (below)

6.1 Example information screens

The section outlines examples of the types of information notices and data pages rendered on the LCD display panel for a standard environment using factory settings. It illustrates typical information that a user is likely to see during normal operation. This can vary depending on the operational environment, firmware version and how the product is configured.

6.1.1 Startup

6.1.1.1 Boot screen

The Boot screen displays after power up or reset and progresses through a code checking sequence as shown in Figure 6–3. If boot problems occur, the product raises an error. Contact the Customer Service Centre.

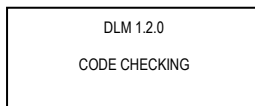


Figure 6–3: Boot screen

6.1.1.2 Version screen

If the boot sequence is successful, a Version screen reflects the product name, serial number, firmware version and PGA version as shown in Figure 6–4. The product automatically pages through the various information notices and data pages, including existing measurement results.

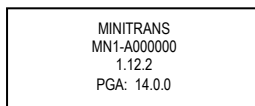


Figure 6–4: Version screen

6.1.1.3 Standby mode

An information notice indicates the operational mode as shown in Figure 6–5. *Standby* mode is the initial operational mode. If scheduled measurements are configured, they will occur automatically at the scheduled time (see Section 6.1.2.3). If there are no scheduled measurements, the notice shown in Figure 6–6 displays.

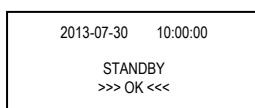


Figure 6–5: Standby mode

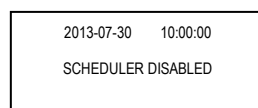


Figure 6–6: Scheduler disabled

6.1.1.4 Peripheral Scheduler

An information notice lists all peripheral connections as shown in Figure 6—7. If the peripheral scheduler is enabled, all analogue inputs are listed with corresponding null values. The product has analogue inputs Aln1 to Aln6, but corresponding values for these appear after peripheral(s) are connected. By default, a newly shipped product has no connected peripherals, but a configured installation may have a load sensor connected.

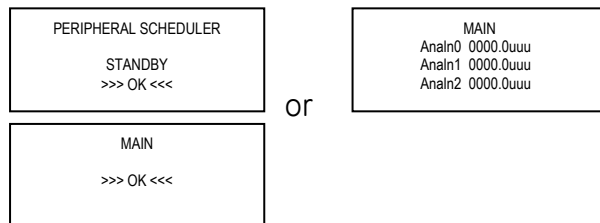


Figure 6—7: Peripheral scheduler

6.1.2 Manual measurements

6.1.2.1 Start a manual measurement

Use TransConnect to start a manual measurement on the main tank. The timer automatically counts down from 10 seconds and indicates that a manual measurement is about to proceed. Figure 6—8 shows the relevant screens.

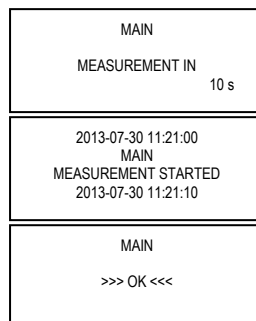


Figure 6—8: Start a manual measurement

6.1.2.2 Stop a measurement

Use TransConnect to stop an active measurement. After any remaining oil in the headspace drains, the product returns to *Standby* mode as shown in Figure 6—9.

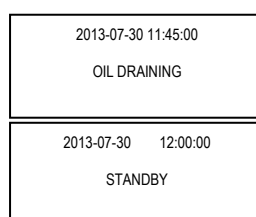


Figure 6—9: Stop a measurement

6.1.2.3 Measurement data

The product automatically pages through the screens and measurement data of the last analysis. For example, data for the main tank is shown in Figure 6–10. **Note:** If nitrogen measurement is not enabled, the nitrogen and total gas concentration is omitted.

MAIN	
LAST MEASUREMENT 2013-07-30 12:48:10	
MAIN	
H2	15220.0 ppm
C2H2	2345.0 ppm
MAIN	
H2O	1040.0ppm
C0	222.0ppm
MAIN	
AIN 1	-1.111xxx
MAIN	
NEXT MEASUREMENT 2013-07-30 16:48	

Figure 6–10: Measurement data

6.1.3 Manual oil sampling

6.1.3.1 Take a manual oil sample

If a manual oil sampling arrangement is fitted, perform the oil sampling according to the sampling process (see Section 7). Wait until the current measurement process is complete or use TransConnect to stop the current measurement process (see Section 6.1.2.2). The system returns to *Standby* mode as shown in Figure 6–11:

2013-07-30 12:00:00
STANDBY

Figure 6–11: Standby mode

Manual oil sampling shall be performed while the product is in *Standby* mode preferably *after* a measurement cycle when fresh oil is at the sampling point. **Note:** the product does not have an oil purging step.

6.1.4 Further system specifications

6.1.4.1 Communications channels

The product has two serial communications channels. For example, default configuration details are shown in Figure 6—12, such as the interface, protocol, baud rate, modbus address and parity error-checking format:

ChA RTU	1	RS232
19200	0	
ChB: ASC	1	GSMGPRS
57600	0	

Figure 6—12: Communication channels

6.1.4.2 Networking

If Ethernet is enabled and a RJ-45 connection made, relevant network details are shown. For security reasons, all network details are hidden by default as shown in Figure 6—13, but these can be software enabled.

IP: XXX.XXX.XXX.XXX
SUB: XXX.XXX.XXX.XXX
GW: XXX.XXX.XXX.XXX
TCP: 502

Figure 6—13: Networking

6.1.4.3 Other system details

Additional information notices reflect the configuration of the product. For example, if a GSM/GPRS modem is fitted, additional pagels) as shown in Figure 6—14 reflect the communications provider, signal strength and any problems.



Figure 6—14: GSM / GPRS modem

Notes:

- Actual product values depend on the installation at any moment in time.
- Actual parameter format can vary e.g. O₂ or Oxygen.
- See Section 6.2 for a list of error codes that can occur on the LCD display panel and their meaning.
- System Failure mode limits functionality and the availability of certain screens. Contact the Customer Service Centre.

6.2 Error Codes

A list of error codes that can appear on the LCD display panel and their meaning are shown in Table 6–1.

NOTE: Error codes are offset by 1 from the Modbus register bit numbers.

Table 6–1: Error codes

Error code	Description
00	Missing mains input
01	PGA power supply voltage too low
02	PGA chopper frequency outside range
03	PGA IR-source outside range
04	Gas flow lower than limit
05	Background noise/vibration too high
06	Microphone test failed
07	Not level sensor 1 pulses (level)
08	Not level sensor 3 (drain)
09	Level sensor 1 (level)
10	Level sensor 2 (level alert)
11	PGA Air temperature outside limits
12	Bad communication with control PCB
13	Gas leak test: Pump pressure too low
14	Gas leak test: Pressure decay too high
16	Oil temperature too low
17	Oil temperature too high
18	Oil pressure too low
19	Oil pressure too high
20	Oil pump tacho count too high
21	Oil pump pressure too low
22	Oil pump speed out of range
23	Manual oil sampling switch
24	Oil pump tacho count too low
25	{not used/defined}
26	5 V supply below 4.5 V
27	Temperature Sensor(s) 1 disconnected
28	Temperature Sensor(s) 2 disconnected

7 MANUAL OIL SAMPLING

7.1 Sampling Arrangement

The optional oil sampling port (if fitted) is located on the oil inlet on the base of the product. This gives access to fresh oil via a manual sampling arrangement as shown in Figure 7–1 to Figure 7–3.

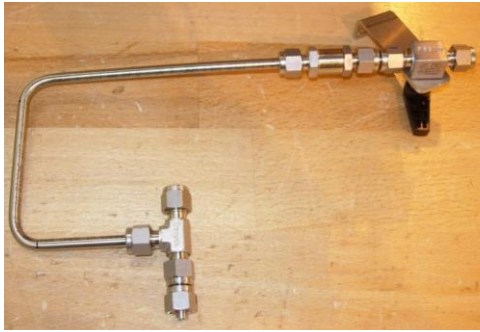


Figure 7–1: Manual sampling arrangement



Figure 7–3: PTFE tubing



Figure 7–2: Product fitted with manual sampling arrangement



Before commencing work, ensure the use of suitable protective gloves, such as nitrile rubber.

Perform the manual oil sampling according to the sampling process outlined in Figure 7–4. GE recommends the use of a 50-ml ground glass syringe. Manual oil sampling shall be performed while the product is in *Standby* mode – either wait until the product returns to *Standby* mode or force the product to stop the current measurement cycle using the TransConnect software. The optimum time to perform a manual sample is just after the product has completed a measurement because fresh oil will be at the manual sampling point.



Note: Collecting a manual sample while the product is performing a measurement is not recommended as this could potentially affect the readings.

7.2 Sampling Process

Observe the PRODUCT operating mode on the LCD display panel. Figure 7—4 outlines the steps to obtain a manual oil sample.

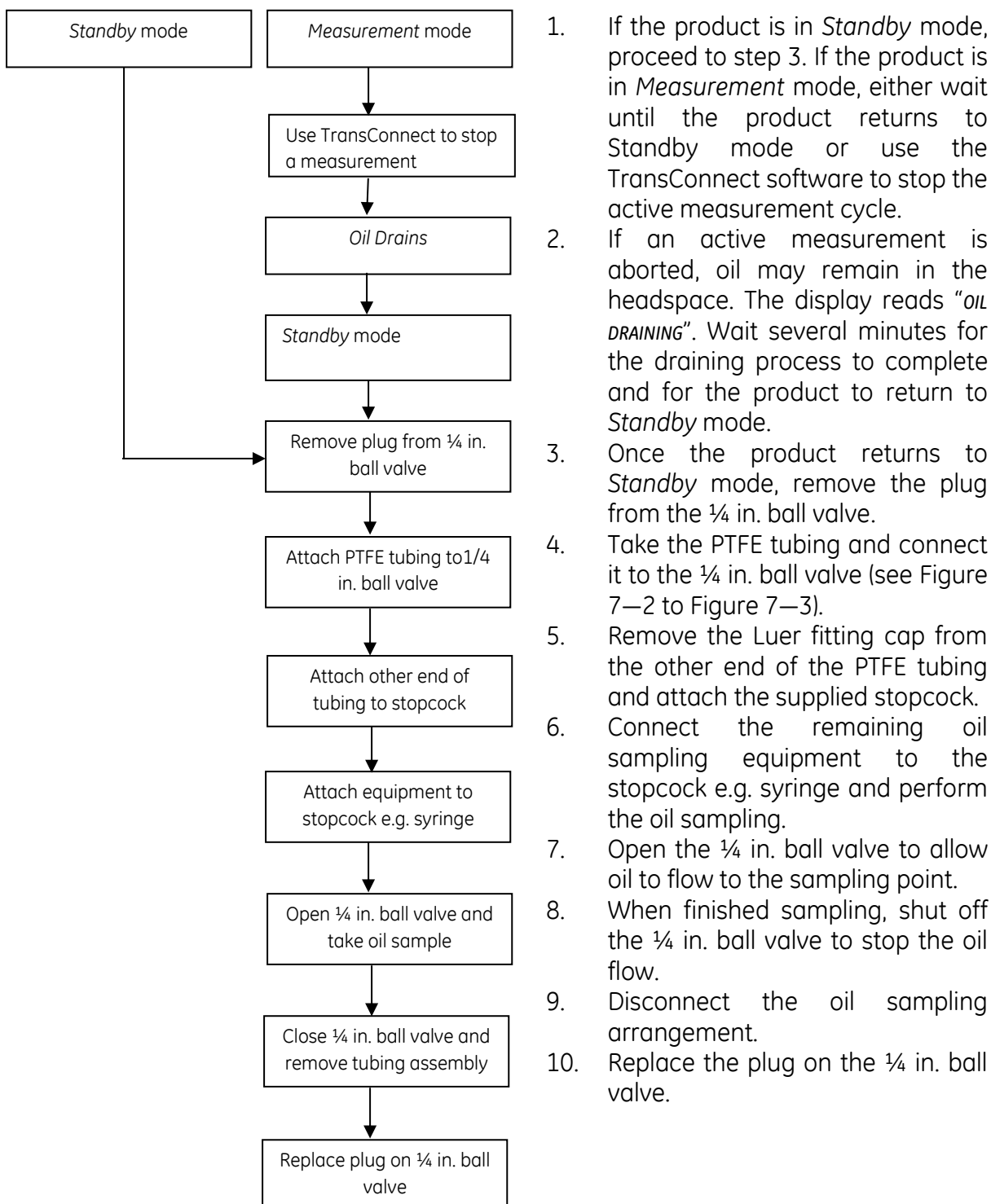


Figure 7—4: Manual oil sampling process

See 6.1 for product display panel information.

8 AIR FILTER CLEANING

The product draws air from the left-hand side and expels it on the right. The intake air is filtered to remove the largest particles, so depending on environmental conditions the air filter as shown in Figure 8–1 and may need occasional cleaning. The outlet filter may also require attention.

Note: A higher temperature in zone two can be an indication that such action is required.




Figure 8–1: Air filter assembly without cover



Figure 8–2: Air filter with cover

To clean the air filter:

1.  First isolate the product through the external circuit breaker or external switch.
2. To remove the cover, use a flat-head screwdriver or the supplied tab-pushing tool to push the tab on the lower part of the fan cover as shown in Figure 8–1.
3. If a cable-tie is fitted to the filter holder, first carefully remove it. Remove the filter holder by pulling off the black snap-off cover to the filter as shown in Figure 8–2.
4. If the filter mat is just dusty, clean it with dry compressed air or by beating it against a hard clean surface.
5. If the filter mat is oily, clean it with mild detergent and water, and then dry it thoroughly.
6. Replace the filter mat and snap the cover back in place. Note: The cable tie only secures the filter holder during shipping so there is no requirement to replace.
7. Repeat for the other filter.
8. Re-energise the product and it will automatically begin measuring at the next scheduled time.

9 OIL FILTER CLEANING

The oil is filtered to prevent particles from entering the product, or to prevent particles from being returned to the transformer. Therefore this filter may need occasional cleaning. Figure 9—1 and Figure 9—2 show the oil filter housing and oil filter respectively.

Note: A non-critical error in the product data file, such as error code 18 or 20 can be suggestive of such action.



Figure 9—1: Oil filter housing





Figure 9—2: Oil filter



Before removing the filter housing, first isolate the product through the external circuit breaker or external switch and ensure that the oil supply valve is closed.

To clean the oil filter:

1. If a measurement is in progress, use the TransConnect software to stop the measurement process and return the product to *Standby* mode.
2.  Isolate the product through the external circuit breaker or external switch.
3.  Remove the 1 in. nut that secures the filter housing using a suitable wrench. Note: Ensure that the wiring around the housing is not damaged in the process. Care must be taken because there is also a spring behind the filter. Note: A little oil may leak out.
4. Remove the filter and clean it using a brush and compressed air. Then replace the filter back into its housing and re-secure the housing.
5. Replace the nut, but use a second wrench to hold the filter housing in place while the nut is tightened to 65 N.m with a torque wrench.
6. Re-energise the product and it will automatically begin measuring at the next scheduled time.

10 COMMUNICATIONS

See the Communications section of the MINITRANS Installation Manual for available communication options.

11 MODBUS PROTOCOL

See document 32-0245 for details of the Modbus protocol for all products.

12 SERVICE LOGS

Service logs can be obtained by using either the Kelman Download utility or the PERCEPTION transformer monitoring software v1.12 or later. See the 'Downloading service logs' section in the PERCEPTION User Guide.

13 TECHNICAL SUPPORT

For technical support, please contact the GE Customer Service Centre. Available 24 hours a day, 365 days a year.

+1-800-361-3652 toll free (US/Canada)

+1-514-420-7460 (worldwide)

ge4service@ge.com

Appendix A Time Sync Implementation

The product has a time-sync feature that allow users to synchronize the clock time on the product. This Appendix explains the data format options for the “time sync” and its implementation.

A.1 Time Format

Under the standard Modbus® register list, the timing is defined in Table A—1:

Table A—1: Timing

Register	Permissions	Group Size	Description	Data Format
1200	R/W	4*	UTC Clock: Years	YYYY (BCD)
1201			UTC Clock: Months, days	MMDD (BCD)
1202			UTC Clock: Hours, minutes	HHMM (BCD)
1203			UTC Clock: Seconds, Day of week (0-6, 0 Sunday)	SSWW (BCD)

This R/W (read/write) register is in BCD format (Binary Coded Decimal). Some systems are not compatible with this data format.

**Note: The time registers can be written separately in 5 seconds interval in any order. This feature is available starting TransfixHost v1.12.4.*

A.2 UNIX® Epoch register

A UNIX Epoch register was added to the host board firmware (v1.12.2) to make systems integration easier in cases of system incompatibility. Both register formats (BCD & UNIX) will be maintained in future firmware versions and both affect the same single clock. The details of the UNIX time registers are listed in Table A—2:

Table A—2: UNIX time registers

Register	Access Flags	Version	Storage Class	Effect After	Name	Description	Data Format
1197	rg2,wg2	1.12.2	RAM	immediately	RTC_UNIX_TIME	Current Time UTC in UNIX format	32-bit integer
1198							

These registers are readable and writable, but should be written together as a single 32 bit value.

A.2.1 UNIX time format

The number of seconds from the UNIX epoch time of 1st Jan 1970 00:00.

A.2.2 UNIX time example

For reference, the time on a device is reported in TransConnect as 12 Aug 2011 11:56:00 BST and the corresponding value in the registers mentioned above is 13146616.

When testing, please check that you are reading registers 1197-1198 (assuming addresses start at 999 +1) and decoding an unsigned 32 bit big endian number. The epoch time is in UTC. This matches the device time. An online converter e.g. <http://www.epochconverter.com/> can be used to verify.

A.2.3 Register Access Control

The product registers are protected with access flags. The register map details the relevant access flags for each register. Each register may have one or more access flags, separated by commas. Table A–3 lists the supported access flags:

Table A–3: Access flags

Flag	Access	Description
r	Read	Read access to a single register
rgN	Read group	Read access to a group of length N (Nmax = 120)
w	Write	Write access to a single register
wgN	Write group	Write access to a group of length N (Nmax = 120)

Access flags may be modified with the addition of the modifier flags listed in Table A–4:

Table A–4: Modifier flags

Flag	Access	Description
u	User	Only accessible if the master is authorised with user access
c	Config	Only accessible if master is authorised as config (commissioning) user
f	Factory	Only accessible if master is authorised as factory (service) user

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